LIVERMORE LAB REPORT

A weekly review of scientific and technological achievements from Lawrence Livermore National Laboratory March 31-April 4, 2014.

SAN FRANCISCO Business Times ENERGIZE ME

Wind power saw the highest energy gains from 2011 through 2013, according to the most recent U.S. energy flow charts released by LLNL.

Americans used more energy from all sources -- renewable, fossil and nuclear -- in 2013, and also polluted the air with more carbon dioxide, the first increase in CO2 emissions since 2010.

In a new analysis by Lawrence Livermore National Laboratory, Americans used 2.3 quadrillion thermal units, or "quads," more energy in 2013 than in 2012. And America's carbon dioxide emissions went up to 5.39 billion metric tons, the first annual increase since 2010.

To read more, go to the *San Francisco Business Times*.

SCIENCE CODEX SAILING TO THE 'ISLAND OF STABILITY'

The "Island of Stability" is thought to be where superheavy elements reside and last longer than a few milliseconds.

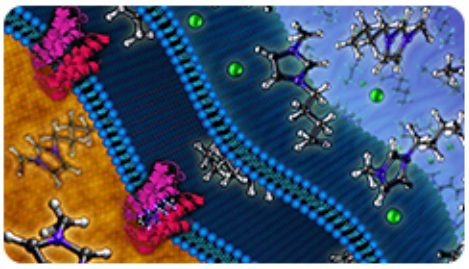
For the last several years, Lawrence Livermore scientists and an international consortium have been exploring the uncharted territory on the periodic table of elements known as the "Island of Stability."

The island is the home of a new genre of superheavy chemical elements sought for more than three decades.

The "sea-and-island" analogy arose because these superheavy elements lie in an area of the periodic table where other elements are unstable, disappearing in much less than the blink of an eye. The superheavies, in contrast, are somewhat more stable than their shorter-lived cousins.

Yuri Oganessian, of Russia's Joint Institute for Nuclear Research in Dubna, and his colleagues teamed with Lawrence Livermore Laboratory to synthesize six new elements (113, 114, 115, 116, 117 and 118) over the past six years. Such superheavy elements do not exist in nature and can be created only by smashing lighter elements together at tremendous speeds obtained by means of highly sophisticated particle accelerators.

To read more, go to *Science Codex*.



Livermore researchers discovered a resistance mechanism in a rainforest soil bacterium that enables *E. coli* to grow and produce biofuel in the presence of ionic liquids at levels that otherwise would be toxic to native strains.

Lawrence Livermore researchers with colleagues from the Joint BioEnergy Insitute have identified the genetic origins of a microbial resistance to molten salts (ionic liquids) and successfully introduced this resistance into a strain of *E. coli* bacteria for the production of advanced biofuels.

The ionic liquid resistance is based on a pair of genes discovered in a microbial species native to a tropical rainforest in Puerto Rico.

The new genes show that *E. coli* has the ability to grow in the presence of normally toxic levels of an ionic liquid, making it possible to produce biofuels more efficiently.

To read more, go to *Red Orbit*.

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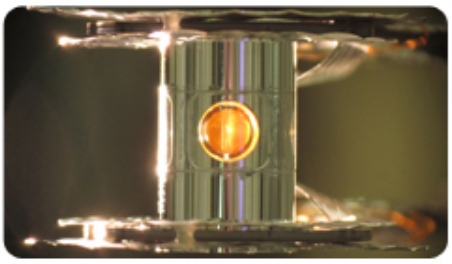
BABY STEPS TOWARD FUSION



A deuterium and tritium capsule (sphere in window at center) inside a cylindrical hohlraum provides a fuel for fusion.

Researchers at Lawrence Livermore's National Ignition Facility recently achieved a breakthrough on the road to fusion, the same energy that powers the sun and stars, by achieving fuel gains greater than 1.

In a series of experiments, scientists attained fuel gains that showed an order of magnitude improvement in yield performance over past experiments.

The experimental results have matched computer simulations much better than previous experiments, providing an important benchmark for the models used to predict the behavior of matter under conditions similar to those generated during a nuclear explosion. NIF's primary goal is to ensure the safety and security of the nuclear stockpile.

To see more, go to *Al Jazeera*.

APS physics

WATCH OUT

Global map of reactor neutrino emission. Photo courtesy of Glenn Jocher and John Learned, University of Hawaii

The Department of Energy is funding WATer CHerenkov Monitor of AntiNeutrinos (WATCHMAN), a prototype neutrino detector that can monitor whether a nuclear reactor 400 kilometers away is enriching the raw material for nuclear weapons.

If successful, the WATCHMAN collaboration's research could make it nearly impossible for countries to hide their illicit nuclear enrichment. It also marks the start of the neutrino's transformation into a practical tool for uses outside of basic research.

All nuclear reactors emit radiation and antineutrinos. While radiation can be blocked with a few feet of soil or concrete, antineutrinos pass unimpeded through hundreds of miles of solid Earth.

"That's the beauty of this signal: You won't be able to stop it or shield it," said Adam Bernstein of Lawrence Livermore and head of the Watchman collaboration. "Neutrinos have no nationalities."

To read more, to the *American Physical Society (APS)*.

LLNL applies and advances science and technology to help ensure national security and global stability. Through multi-disciplinary research and development, with particular expertise in high-energy-density physics, laser science, high-performance computing and science/engineering at the nanometer/subpicosecond scale, LLNL innovations improve security, meet energy and environmental needs and strengthen U.S. economic competitiveness. The Laboratory also partners with other research institutions, universities and industry to bring the full weight of the nation's science and technology community to bear on solving problems of national importance. To send input to the *Livermore Lab Report*, send e-mail